



A.D. 1865, 28th DECEMBER. N° 3357.

Telegraphic Cables or Conductors.

LETTERS PATENT to Cromwell Fleetwood Varley, of Fleetwood House, Beckenham, in the County of Kent, for the Invention of "**IMPROVEMENTS IN THE CONSTRUCTION OF TELEGRAPHIC CABLES OR CONDUCTORS.**"

Sealed the 15th June 1866, and dated the 28th December 1865.

PROVISIONAL SPECIFICATION left by the said Cromwell Fleetwood Varley at the Office of the Commissioners of Patents, with his Petition, on the 28th December 1865.

I, CROMWELL FLEETWOOD VARLEY, of Fleetwood House, Beckenham, in
5 the County of Kent, do hereby declare the nature of the said Invention for "**IMPROVEMENTS IN THE CONSTRUCTION OF TELEGRAPHIC CABLES OR CONDUCTORS,**" to be as follows:—

This Invention has for its object improvements in the construction of telegraphic cables or conductors. In telegraphic cables as at present con-
10 structed a minute fault in the insulator when the cable is laid will ultimately render the cable useless, as the copper of the conductor where it is exposed becomes eaten away by electrolitic action. To obviate this danger I make one or more of the wires of the strand forming the conductor either entirely or in part of platinum, and then should the copper be thus eaten away the
15 platinum remains and is sufficient to carry a current. At the present time in joining the conductor it is usual to solder the two ends of the conductor together and to coil fine copper wires around the joint spirally, in such manner that should the joint break the spirals stretch out, and the fine wires are sufficient to carry a current over. Now I make one or more of the
20 spirals of each joint of platinum, so that should water penetrate to the

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wires they may not be entirely eaten away. In place of platinum gold and some other metals may be employed. Also in constructing long telegraphic cables, in place of making the conductor and the insulator of the same thickness from end to end of the cable, as is most usual, I make the conductor smaller and smaller in passing from shore ends towards the centre 5 of the cable, and at the same time, that is to say, in passing from the shore towards the centre, I make the thickness of the insulator to bear a continually increasing ratio to the diameter of the conductor. One of the advantages of this arrangement is, that the protection of the cable from injury from earth currents is rendered more efficient as the danger increases. 10 It will be desirable to select the gutta percha and employ the highest quality near the centre of the cable. These improvements admit of the copper and gutta percha of the cable being combined in cheaper proportions to obtain the same speed of working, and the thickness of the gutta percha may be decreased, when the consequences of a fault 15 are not so fatal as they have been heretofore. In order to render the insulated conductor less liable to injury from abrasion and otherwise, I employ in the insulation, either in part or entirety, strips or bands of woollen fabric saturated or filled with Chatterton's compound gutta percha or other insulating compound or material, and these strips are 20 lapped over the conductor, either previously covered or otherwise. In place of woollen fabrics woollen yarns or cords may be employed. I am aware that it has been proposed to use other fabrics and fibres in the manner above described, but wool being an insulating material and comparatively inexpensive is much superior to the fibres heretofore 25 employed or suggested for use for this purpose.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Cromwell Fleetwood Varley in the Great Seal Patent Office on the 28th June 1866.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, CROMWELL FLEETWOOD VARLEY, of Fleetwood House, Beckenham, in the County of Kent, send greeting. 30

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-eighth day of December, in the year of our Lord One thousand eight hundred and sixty-five, in the twenty-ninth 35 year of Her reign, did, for Herself, Her heirs and successors, give and

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grant unto me, the said Cromwell Fleetwood Varley, Her special licence that I, the said Cromwell Fleetwood Varley, my executors, administrators, and assigns, or such others as I, the said Cromwell Fleetwood Varley, my executors, administrators, and assigns, should at any time agree with, and
5 no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN
10 THE CONSTRUCTION OF TELEGRAPHIC CABLES OR CONDUCTORS," upon the condition (amongst others) that I, the said Cromwell Fleetwood Varley, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal
15 Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Cromwell Fleetwood Varley, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by
20 the following statement thereof, that is to say :—

This Invention has for its object improvements in the construction of telegraphic cables or conductors. In telegraphic cables as at present constructed a fault in the insulator when the cable is laid will ultimately render the cable useless, as the copper of the conductor where it is exposed
25 becomes eaten away by electrolytic action. To obviate this danger I make one or more of the wires of the strand forming the conductor either entirely or in part of platinum, and then should the copper be thus eaten away the platinum remains and is sufficient to carry the electric current. One of the methods I have adopted for this purpose consists of inserting
30 a platinum rod inside a hollow copper cylinder, and then drawing them down together into wire. In this way copper wire is formed containing a fine platinum interior. Another plan consists of making the centre wire of the conductor a strand of fine wires, one, two, or more of which are platinum wires. A third plan consists of making the copper
35 conductor wholly of fine wires, one or more of them being platinum. I prefer giving the strand a much more rapid lay than that usually adopted, so as to allow it to go and come with the cable when the latter is sprung by the operation of laying or picking up. At the present time in joining the conductor it is usual to solder the two ends of the

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conductor together and to coil fine copper wires around the joint spirally, in such manner that should the joint break the spiral wires stretch out, and the fine wires are sufficient to carry a current over. Now I make one or more of the spirals of each joint of platinum, so that should water penetrate to the wires they may not be entirely eaten away. In place of platinum 5 gold and some other metals may be employed. Also in constructing long telegraphic cables, in place of making the conductor and the insulator of the same thickness from end to end of the cable, as is most usual, I make the conductor smaller and smaller in passing from the shore ends towards the centre of the cable, and at the same time, that is to say, in passing 10 from the shore towards the centre, I make the thickness of the insulator to bear a continually increasing ratio to the diameter of the conductor. It is impossible here to lay down the best dimensions to be used, because they vary with the price of the materials, and must be calculated for each circuit by a competent electrician, who must also take into account the 15 resistance of the particular kinds of instruments and batteries at each end of the circuit. I prefer that in a cable not joined to a land line the shore end should have not less than four times as much copper as the centre portion. One of the advantages of this arrangement is, that the protection of the cable from injury from earth currents is rendered more efficient, as the 20 danger of the electricity breaking through the insulator increases towards the middle of the cable. It will be desirable to select the gutta percha and employ the highest quality near the centre of the cable. The above improvements admit of the copper and gutta percha of the cable being combined in cheaper proportions to obtain the same speed of working, and in consequence 25 of the platinum wire the thickness of the gutta percha compared to the conductor may be decreased, when the consequences of a fault are not fatal as they have been heretofore. In this way considerable economy can be effected; for instance, a cable containing 300 lbs. of copper and 400 lbs. of gutta percha will work no faster than one containing 330 lbs. copper 30 and 330 lbs. gutta percha; the latter being an expensive article the gain is obvious; hitherto an excess of gutta percha has been used to leave a large margin of surplus insulation. In order to render the insulated conductor less liable to injury from abrasion and otherwise, I employ in the insulation, either in part or entirely, strips or bands of woollen fabric 35 saturated or filled with Chatterton's compound gutta percha or other insulating compound or material, and these strips are lapped over the conductor, either previously covered or otherwise. In place of woollen fabrics woollen yarns or cords may be employed. I am aware that it has been

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proposed to use other fabrics and fibres in the manner above described, but wool being an insulating material and comparatively inexpensive is much superior to the fibres heretofore employed or suggested for use for this purpose. The wool used for these purposes must be cleansed from grease.

- 5 When the conductor of a cable is constructed as above described, should a fault in the insulation show itself it is desirable to preserve the copper of the conductor as long as possible. To effect this I employ condensers, as described in my Patent of 1862, No. 3453, with the addition of a battery consisting of a large number of cells of small dimensions and of
- 10 great resistance, so as to keep the cable always negative to the earth, namely, insert between the cable and the telegraph instruments at each end a condenser of large capacity, say equal to one-eighth part or one-quarter the capacity of the cable; secondly, connect at one or both ends of the cable a battery of 500 (more or fewer) cells through a large resistance,
- 15 say one million ohms, the positive pole to earth, the negative to the cable. This will keep the copper at the exposed part of the cable always electro-negative, and the condensers, while they cut off nearly the whole disturbance arising from earth currents, still permit the signals to pass freely from end to end. If the condensers alone be used, the copper wire exposed at
- 20 the fault becomes alternately positive and negative; when positive it dissolves, when negative it is deposited not in a compact but in a spongy form, and in one case which came under my experience ultimately connected the copper conductor through the yarn with the outer iron covering. The battery must have so many cells that it will always overpower any earth
- 25 current; should, however, the earth current on any exceptional occasion exceed that of the battery the latter should be immediately disconnected, and the cable left to the partial protection afforded by the condensers. The platinum wire, however, will never eat away when the copper is all gone; it is obviously best to preserve the copper as long as possible. It will be
- 30 advisable to insert a galvanometer in the battery circuit to give notice should the earth current overpower it.

In witness whereof, I, the said Cromwell Fleetwood Varley, have hereunto set my hand and seal, this Twenty-sixth day of June, One thousand eight hundred and sixty-six.

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CROMWELL FLEETWOOD VARLEY. (L.s.)

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